Knobel. Of German astronomers, while the Congress regrets the absence of Prof. Vogel, it will welcome from the Potsdam Observatory Dr. Scheiner. Prof. Kopteyn of Groningen is also expected. Prof. Bakhuyzen comes from Leyden. Italy is represented by Prof. Tacchini of the Collegio Romano, Padre Denza, the representative of the Vatican, and M. Riccò of Palermo. Russia sends two astronomers, Drs. Donner of Helsingfors and Belopalsky of Pulkova. The Chilian troubles have not prevented the Government of that country accrediting M. Maturana; while Brazil illustrates its interest in the scheme by despatching M. Beuf of Rio de Janeiro.

Of course the French astronomers are strongly represented: M. Rayet of Bordeaux, M. Trépied of Algiers, and M. Baillaud of Marseilles, represent the more distant French Observatories; while of the Paris men of science, in addition to MM. Mouchez and Janssen, we may confidently expect the co-operation of MM. Faye, Wolf, Cornu, and Henri *frères*.

An informal meeting was held on Saturday last at the Observatory to draw up a paper of agenda containing the points which it was thought that the Congress should consider. This does not exclude any other points which may prove of interest in the course of the debate.

The following programme, to be submitted to the General Congress, was drawn up:—

1. Verbal reports on the astrophotographic installations.
2. Exhibition of the photographs obtained, and the discussion of the most desirable point of exposure with regard to the focus.
3. The mode of printing the *réseau.*
4. Report on the various kind of plates and photographic processes and developments.
5. On the formation of a catalogue of guiding stars.
6. (*a*) On the desirability of increasing the distance of the guiding stars from the centre of the plate.
   (*b*) On the best form of micrometer for the guiding telescope.
7. On the orientation of the plate.
8. Is it desirable that the plates for the catalogue and the chart be taken on the same evening?
9. To determine the length of the exposure in the catalogue plates, and whether it be desirable to increase it.
10. Is it desirable to make three exposures on the same plate?
11. To fix the minimum diameter which the 11th and 14th magnitude star images shall have on the plate.
12. To discuss the possibility of determining a relation between the diameter and time of exposure.
13. To obtain a definition of the 14th magnitude.
14. The method of measuring the negatives and the employment of the *réseau.*
15. To discuss
   (*a*) The number of fundamental stars for each negative.
   (*b*) The choice of these stars.
   (*c*) The proper plan to assure the meridian observation of these stars.
16. On the method of reproduction of the plates for the chart.
17. (*a*) To discuss the desirability of a Central Bureau for measuring and discussing the plates.
   (*b*) Shall Observatories possessing measuring instruments begin to measure at once?
18. To discuss when the work should be begun.
19. Should there be plates of longer exposure in the neighbourhood of the ecliptic?

No. 10 seems to require some explanation. It has been found by MM. Henry that the visibility of minute stars is much assisted if there be three exposures a line; and it is possible that a proposition will be made to do away with the very short exposures and to substitute three separated from each other in length of exposure by an equal or nearly equal interval of time.

## PHOTOGRAPHIC PERSPECTIVE AND THE USE OF ENLARGEMENT.

It is not uncommon to hear it remarked that photographs make hills look low, or that they make things look "such a long way off"; and that they do so in a great many cases is perfectly true.

In explanation of the apparent lowness of photographed mountains, I have heard it suggested that the eye judges horizontal and vertical distances by different standards, and this, too, is probably the case; but since there is a horizontal and a vertical in a picture as well as in nature, the eye ought to form similar judgments on both.

The true meaning of the appearances alluded to, though they admit of a most simple explanation, is not as generally understood as might be expected.

The fact is that they depend merely on perspective.

In elementary books on drawing there often appears a diagram in which imaginary threads are supposed to be stretched from every point of an object, through an upright sheet of glass, and to intersect in some point behind it. The trace of these threads on the glass will there form a picture of the object which is in true perspective, when viewed from the intersection of the threads; and if the proper amount of light, shade, and colour be supposed to be added, this picture, to the single eye so placed, would be absolutely undistinguishable from the object itself.

But now suppose the eye is not at the place of intersection of the threads, but a certain distance further off or nearer to the glass. It is evident that the apparent angular magnitude of every object in the picture is altered in the ratio of the distance of the intersection of the threads to the distance of the eye from the glass. But this is exactly what would be the case, if, keeping the eye at the intersection of the threads, a new picture were formed on the glass either by altering the size of the real objects in this ratio, or their distance from the glass in the inverse ratio.

For instance, let the objects forming the picture be two towers, one say half a mile off and the other a mile, and suppose that the intersection of the threads is one foot behind the glass; to the eye placed at that distance the towers in the picture will subtend the same angle as they do in reality; but if the eye be moved a foot further from the glass these angles will be halved, and the same picture will then fall on the retina as would be formed there were the eye one foot from the glass and the towers only half their actual size, or if they were removed to the distances of one mile and two miles respectively.

Thus by viewing the picture from the wrong distance, either the apparent size of the objects represented by it is multiplied by the ratio $\frac{\text{true distance}}{\text{wrong distance}}$, or their apparent distances by $\frac{\text{wrong distance}}{\text{true distance}}$.

Putting this in symbols, for the sake of simplicity and brevity, we have, if D = true distance of an object from the point of view, A = its real linear magnitude, F = distance at which the picture must be viewed in order to convey a correct impression of D and A. Then if $d$, and $a$, are the values corresponding to D and A, when the picture is seen from the distance $f$, we have $d = \frac{f}{F} D$ when A is judged correctly; $a = \frac{F}{f} A$ when D is judged correctly. Of course both A and D may be misjudged, but apparent and true distances and sizes are still connected by the relation

$$ad = AD.$$

In a photograph, F is the focal length of the lens with which it was taken, and $f$ the distance at which it is looked at. Thus, if, as is generally the case with all

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moderate sized pictures, the focal length of the lens is less than the distance one would naturally hold the picture at for convenient view, the inevitable result is either that the apparent distances of the picture are greater than the real ones in the proportion of $\frac{f}{F}$, or that the apparent sizes of the things represented in it are reduced in the proportion $\frac{F}{f}$, or a combination of both these wrong impressions is produced.

Which of these effects or what combination of them is suggested depends much on the nature of the picture itself.

In interiors taken with a wide-angle, short-focussed lens, distances are enormously exaggerated, while in landscapes it is generally the sizes of things which seem diminished.

As a rule, it may be said that objects which do not themselves suggest any scale will be made to look small, while those which do, such as men, houses, &c., will appear distant.

When $\frac{F}{f}$ is greater than unity, *i.e.* when the picture is viewed too near, the reverse of the above effects is seen; and as far as the perspective is concerned, the scene is being viewed through a telescope.

The magnifying power of a telescope is the focal length of the object-glass divided by the focal length of the eye-piece, or, in other words, the distance from the lens at which the image is formed divided by the distance from which it is viewed.

If the focal length of the eye-piece is the same as that of the object-glass, there is no magnification, and in the field of the telescope will be seen an exact reproduction of the natural view.

When, however, by shortening the focal length of the eye-piece, magnification is obtained, foreshortening of all the distances in the ratio $\frac{F}{f}$ naturally takes place.

This may be practically illustrated in rather a striking way by looking from a railway bridge along a straight piece of line at an approaching train.

Supposing the train to be travelling at forty miles per hour, if the telescopic power be forty, the apparent rate of approach will be only one mile per hour.

From what has been said, it will be clear that just the same laws apply to photographic pictures (or any pictures in true perspective) as to telescopic images, and that there is only one distance at which they will convey a correct impression to the eye.

This being so, it is evident that any photograph taken with a lens of less than about a foot focal length, must exaggerate all the distances, or make objects in the picture look smaller than they should, and the only remedy for this is to enlarge the picture until the right distance to view it from becomes also the convenient distance.

Even if this be done, however, there is still a tendency to view the picture too far off; for few lenses, except those for portraits embrace an angle so small as to be taken in at a single glance, and people are naturally inclined to stand far enough from a picture to see the whole of it at once.

Still, a proper amount of enlargement offers the best means of making a photograph give a true idea of the scene which it represents; and this is especially true of the small pictures taken by so-called "detective" cameras, having lenses varying from four to six inches in focal length; and it is for this end, and not, in general, to enable more detail to be seen, that the enlarging process is most useful.

Of course, negatives for enlargement must be well enough defined to bear being examined from the focal distance of the lens which took them, or less than this (since detail is lost in the enlarging process), and many which would pass muster well enough when held a foot or more off will be found imperfect when looked at from the lesser distance.

In a subsequent article I will, if the Editor permits, enter more fully on the subject of photographic definition and its limits, both as they depend on the nature of the various sensitive films, and on the lenses by which the image is formed.

A. Mallock.

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## *ÉMILE GAUTIER.*

COLONEL GAUTIER was born on April 18, in the year 1822, at Geneva, where he made his first studies. When he had concluded his course at the ancient Academy, his tastes and natural talents inclined him to astronomy, the science to which he had been early initiated by his uncle, Alfred Gautier, then Director of the Observatory. In order to perfect himself in his studies, he went to Paris, where, thanks to the recommendations of his uncle, and more especially of Frederic Maurice, a member of the Institute, with whom he was on excellent terms, he entered the Observatory and became the pupil of the celebrated astronomer Leverrier. One of the early recollections that Émile Gautier loved particularly to recall was the time when he worked under the direction of the illustrious *savant* at the calculations of the perturbations of the planets; he went over again in duplicate all the calculations relative to the perturbations of Uranus, calculations which Leverrier had presented to the Academy of Sciences in November 1845.

After a stay of about two years in Paris, he returned to Geneva, and published in December 1846 a thesis prompted by the mathematical works in which he had taken part; it was entitled "An Essay on the Theory of the Perturbations of Comets." In the year 1847, he sojourned for several months in England, where he made the acquaintance of several eminent English astronomers, among whom were Airy, Challis, Adams, and perhaps others.

On his return he spent some months at Paris, where he made various astronomical researches, and determined among others the elements of the planet Metis. He afterwards returned to Geneva, where, in conjunction with Emile Plantamour, then Director, he worked at the Observatory, especially at magnetic observations.

In 1849 he married Mdlle. V. Sarazin Maurice, granddaughter of Frederic Maurice, already mentioned. He leaves two sons: the elder, Lucien, is at present Professor of Hebrew at Lausanne; the younger, Raoul, in the beginning of 1890 was nominated Professor of Astronomy at the University of Geneva, and succeeded his father at the commencement of the same year as the Director of the Observatory.

In the early part of the year 1850, pressed by Colonel Aubert and General Dupour, Gautier turned his attention more especially towards a military career, for which he possessed remarkable qualities. His advancement was rapid, and he was considered one of the best officers in the Swiss army. We need not here follow this part of his life, nor note the various administrative functions in connection with which he introduced useful innovations. This subject would lead us far from the limits of this article. We may say, nevertheless, that in his numerous occupations he never lost sight of astronomy, but constantly made himself acquainted with its current progress.

In 1860 he went to Spain to observe the total eclipse of the sun on July 18 at Taragona (Aragon), and gave an account of his observations in the *Archives des Sciences Physiques et Naturelles*, a publication in which the majority of his works were printed. About this time he had recognized the nature of solar prominences, and defended

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